

BSTZ No. 06639P002
Express Mail No. EV323392921US

UNITED STATES PATENT APPLICATION

FOR

AN INTERLOCKING MECHANISM FOR A DISPLAY

Inventors:

Toshiyuki Tanaka
Hiroshi Nakamura
Martin P. Riddiford

Prepared by:

Blakely, Sokoloff, Taylor & Zafman LLP
12400 Wilshire Boulevard, Suite 700
Los Angeles, California 90025
(714) 557-3800

AN INTERLOCKING MECHANISM FOR A DISPLAYField

[0001] Embodiments of the invention generally relate to the field of flat panel displays. More specifically, embodiments of the invention relate to an interlocking mechanism that enables a bottom portion of a display housing for a flat panel display to be fastened to or unfastened from a display support member of an electronic device.

General Background

[0002] Over the past decade, there has been increased demand for laptop computers, especially in light of their enhanced data processing capabilities. Operating from either external or portable power sources, conventional laptop computers feature a display housing pivotally connected to a body case. Typically, the display housing features a liquid crystal display (LCD) while the body case features a keyboard and a secondary input device, such as a roller ball or a touch pad for example.

[0003] In order to access the keyboard and view the LCD, a user places the body case on a surface (e.g., the user's lap or a stationary surface) and opens the laptop computer by pivoting the display housing in an upward angular direction

away from the body case. As a result, the user is able to access the keyboard and secondary input device as well as to read the displayed content from the LCD. To close and transport the laptop computer after use, the user pivots the display housing toward the body case and secures the display housing. Such pivoting is accomplished by a hinge attached to a rear surface of the body case.

[0004] Due to the growing popularity of personal digital assistants and tablet computers, laptop computers are now being configured to alternatively operate as a tablet computer, with a stylus operating as the input device. This requires the display housing to be inverted, namely the LCD is positioned to face upward and to rest against the body case.

[0005] U.S. Patent No. 5,268,817 illustrates one mechanism in which a display housing is inverted using a secondary hinge positioned to protrude from two opposite side edges of the display housing. Such inversion converts the laptop computer into a tablet computer. However, this conventional display housing possesses a number of disadvantages.

[0006] For instance, one disadvantage is that this conventional display housing employs two independent locking

mechanisms, namely a pair of locking pins to preclude rotation of the LCD and a lock to attach the display housing to the body casing. Thus, multiple areas of the computer need to be accessed by the user, which makes the locking/unlocking procedure cumbersome. Moreover, independent locking mechanisms may increase overall manufacturing costs and increase the potential likelihood of a structural failure.

.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] Features and advantages of embodiments of the invention will become apparent from the following detailed description in which:

[0008] Figure 1 is a perspective view of an exemplary embodiment of an electronic device placed in a CLOSED position and implemented with an embodiment of the invention.

[0009] Figure 2 is a perspective view of the electronic device of Figure 1 without the display support member.

[0010] Figure 3 is a perspective view of the electronic device of Figure 1 when placed in an OPENED position.

[0011] Figure 4 is a cross-sectional view of the electronic device with a retention hook engaged with a recessed area of a top surface of the body case.

[0012] Figure 5 is a side elevation view of the electronic device of Figure 1.

[0013] Figure 6 is a cross-sectional view of the electronic device illustrating a first embodiment of the interlocking

mechanism with dual fasteners having a second fastener engaged with the display support member.

[0014] Figure 7 is a cross-sectional view of a slot deployed within the display support member for retaining the second fastener.

[0015] Figure 8 is a side elevation view of the electronic device illustrating a second embodiment of a biasing mechanism utilized by the interlocking mechanism with dual fasteners.

[0016] Figure 9 is a side elevation view of the electronic device placed in a partially OPENED position.

[0017] Figure 10 is a side elevation view of the display housing being rotated about an axis of rotation provided by the hinge units.

[0018] Figure 11 is a side elevation view of the electronic device in which the display housing has been fully inverted.

[0019] Figure 12 is a perspective view of an embodiment of the display support member.

DETAILED DESCRIPTION

[0020] Embodiments of the invention set forth in the following detailed description generally relate to an interlocking mechanism for a flat panel display that provides dual fastening capabilities. Herein, at least one embodiment of the invention relates to an interlocking mechanism that comprises a first fastener and a second fastener. The first fastener is adapted to attach a display housing to a body case of the electronic device. The second fastener enables a bottom portion of the display housing to become attached to or detached from a display support member of an electronic device.

[0021] In the following description, certain terminology is used to describe certain features of one or more embodiments of the invention. For instance, an "electronic device" is defined as a consumer electronic product with a flat panel display. In this detailed description, for clarity sake and for illustrative purposes only, the electronic device will be illustrated as a portable computer that can be alternatively converted to a tablet computer. However, it is contended herein that the invention may be utilized in a variety of electronic devices including, but not limited or restricted to personal digital assistants, cellular

telephones, digital cameras, video cameras, navigation systems, and the like.

[0022] Herein, the terms "rotate," "pivot," as well as varying tenses thereof are generally defined as an angular movement about an axis of rotation. Normally, the axis of rotation is fixed. For this detailed description, the terms "vertically" pivoted (or any tenses thereof) generally relates to a rotation along a substantially horizontal axis of rotation. The term "horizontally" pivoted (or any tense thereof) generally relates to rotation along a substantially vertical axis of rotation.

[0023] Referring now to Figure 1, a perspective view of an illustrative electronic device 100 placed in a CLOSED position is shown. Implemented with an embodiment of an interlocking mechanism as described below, electronic device 100 comprises a display housing 110 that is pivotally coupled to a body case 120 through a hinge assembly 130 and a display support member 140.

[0024] For one embodiment of the invention, body case 120 comprises two main panel sections, namely a front panel section 122 and a back panel section 124 (see also Figure 3). These panel sections 122 and 124 are brought together

to enclose hardware components and stored software of electronic device 100. This provides protection against foreign materials and environmental conditions. For this embodiment of the invention, panel sections 122 and 124 are made of non-pliable material such as hardened plastic.

[0025] Display housing 110 houses a flat panel display 111 as well as circuitry for generating a displayable image on flat panel display 111. Examples of flat panel display 111 include, but are not limited or restricted to a liquid crystal display (LCD), a plasma display or the like.

[0026] Returning still to Figure 1, for this embodiment of the invention, display housing 110 comprises two panel sections coupled together. These panel sections include a front display panel 112 (see Figure 3) and a back display panel 114.

[0027] As shown in Figures 1 and 2, back display panel 114 includes a recessed area 115 that is sized to accommodate display support member 140 so that, when electronic device 100 is in the CLOSED position as shown in Figure 1, a top surface 116 of back display panel 114 is substantially coplanar with a top surface 141 of display support member 140.

[0028] Recessed area 115 of back display panel 114 may include one or more recessed portions 117₁-117_N (where $N \geq 1$).

Herein, as an illustrative embodiment, a first recessed portion 117₁ may be an opening to a spacing adapted to maintain the interlocking mechanism as shown in detail in Figure 6. One of the fasteners from the interlocking mechanism may be configured to protrude from first recessed portion 117₁. In one embodiment of the invention, a second fastener 220 protrudes from first recessed portion 117₁ when disengaged, but would be sized so as to not exceed the depth of recessed area 115. As a result, second fastener 220 will not come into direct contact with the top surface of front panel section 122 of body case 120. In another embodiment, second fastener 220 could be configured so as to not protrude from first portion recessed 117₁ when disengaged from display support member 140.

[0029] As shown, second fastener 220 of the interlocking mechanism is illustrated as a fastener having a plurality of prongs separated by a predetermined distance. However, it is contemplated that second fastener 220 may be configured with a single prong as shown below.

[0030] Additionally, a second recessed portion 117₂ may be adapted to maintain a second hinge unit 155 as shown in

detail in Figure 12. Second hinge unit 155 may be a friction hinge; however, it is contemplated that second hinge unit 155 may be a collection of friction hinges or perhaps one or more hinges without a brake mechanism. Also, one or more spring-loaded retention hooks 113 may be positioned within recessed area 115 as shown.

[0031] For one embodiment of the invention, hinge assembly 130 is configured for coupling to a bottom edge 126 of body case 120 and a first end 142 of a display support member 140. As one embodiment of the invention, hinge assembly 130 is adapted with a brake mechanism, such as a torsion bar mechanism or a frictional hinge, in order to maintain display housing 110 at a selected angle of rotation above body case 120. For instance, hinge assembly 130 may be adapted to maintain display housing 110 at an angle A, where "A" ranges between approximately 30 degrees to 150 degrees (see Figure 3).

[0032] A first hinge unit 150 is adapted to a second end 144 of display support member 140. As one embodiment of the invention, first hinge unit 150 is generally positioned at a longitudinal center 151 of back display panel 114 of display housing 110. The portion of display housing 110 between longitudinal center 151 established by first hinge unit 150

and hinge assembly 130 is referred to as the "bottom portion" 119 of display housing 110. It is contemplated, however, that first hinge unit 150 may be offset from longitudinal center 151. First hinge unit 150 enables display housing 110 to be vertically pivoted according to the horizontal axis of rotation established by first hinge unit 150. Similarly, second hinge unit 155 provides greater stability in maintain display housing 110 at a viewing angle or in rotating display housing 110.

[0033] Referring now to Figure 3, a perspective view of electronics device 100 when placed in an OPENED position is shown. Electronic device 100 further comprises a keyboard 180 integrated into body case 120. In addition, a secondary input device 185, such as a touch pad or track ball for example, is integrated into body case 120 as well.

[0034] A first fastener 160 is positioned along a top edge 118 of display housing 110 for fastening to a complimentary fastener 162, which is positioned on a top edge 128 of body case 120. These fasteners 160 and 162, when engaged, prevent the angular rotation of display housing 110 and maintain electronic device 110 in a CLOSED position until disengaged.

[0035] Dual speakers 170 and 172 are integrated into body case 120 and separated by display support member 140. Speakers 170 and 172 are substantially visible when the display housing 110 is placed in a CLOSED position.

[0036] For one embodiment of the invention, one or more channels 190 and 192 are formed on front panel section 122. Each channel 190 and/or 192 includes a recessed area 191 and 193 as further shown in Figure 4. Each recessed area (e.g., recessed area 191) receives a spring-loaded retention hook 113 when display housing 110 is inverted and positioned against body case 120. Spring-loaded retention hooks 113 recoil when bottom portion 119 of display housing 110 is detached from display support member 140. Otherwise, spring-loaded retention hooks 113 are pushed into display housing 110 by display support member 140 when electronic device 100 is in a CLOSED or OPENED position as shown in Figures 1 and 3.

[0037] It is contemplated that different areas of display housing 110 and body case 120 may be adapted with different materials. For instance, a portion 123 of front panel section 122 surrounding secondary input device 185 may be adapted with stainless steel or another metal composition in

lieu of hardened plastic to improve resiliency to damage after prolonged use.

[0038] Referring now to Figure 5, a side elevation view of electronic device 100 of Figure 1 is shown. For this embodiment of the invention, an interlocking mechanism 200 is configured with dual fastening capability. In particular, interlocking mechanism 200 comprises a first fastener 210 and a second fastener 220, which are coupled together by a bar 230. Made of a rigid material such as metal or hardened plastic, bar 230 comprises a first end 232 pivotally coupled to first fastener 210 and a second end 234 fixedly coupled to second fastener 220. As shown herein, bar 230 is utilized as a lever to control the engagement or disengagement of second fastener 220.

[0039] As shown in more detail in Figure 6, a cross-sectional view of electronic device 100 illustrating a first embodiment of interlocking mechanism 200 is shown. Herein, lever 230 is positioned within a spacing 240 formed between front display panel 112 and back display panel 114 of display housing 110. Lever 230 enables second fastener 220 to become engaged with and disengaged from a slot 250 formed within display support member 140. An opening is positioned

within the recessed area of back display panel 114 such as recessed portion 117₁.

[0040] A biasing mechanism 260 may be placed in spacing 240 in order to maintain lever 230 in a first state. For instance, biasing mechanism 260 may be a spring positioned to apply a lateral (horizontal) force against lever 230. This retains second fastener 220 to remain engaged in slot 250 of display support member 140 until additional forces are applied as described below.

[0041] Upon disengaging first fastener 210 and performing an event on first fastener 210, such as depressing first fastener 210 for example, lever 230 is laterally shifted and placed in a second state. As a result, second fastener 220, which is fixedly coupled to lever 230, is also laterally shifted. Thus, as shown in Figure 7, second fastener 220 is adapted to clear a flange 252 of slot 250 and become disengaged from slot 250 when display housing 110 is rotated counter-clockwise.

[0042] As shown in detail in Figure 7, flange 252 features a curved shape that not only assists in preventing second fastener 220 from being disengaged from slot 250, but also assists in the engagement of second fastener 220 into slot

250. It is contemplated, however, that second fastener 220 may be engaged to display support member 140 through a variety of mechanisms, including but not limited to slot 250 without flange 252.

[0043] Alternatively, in lieu of a spring, biasing mechanism 260 may be accomplished by a set of retention bumps 270-272 placed on lever 230 and spacing 240 as shown in Figure 8. For instance, according to this embodiment, when lever 230 is placed in the first state, a retention bump 270 may be positioned between retention bumps 271 and 272. This prevents second fastener 220 of the interlocking mechanism from being disengaged from slot 250. However, when lever 230 is placed in a second state where retention bump 270 is removed from the area between retention bumps 271 and 272 (e.g. bump 270 now to the left of bump 271), second fastener 220 may be disengaged from slot 250.

[0044] More specifically, when laterally shifted inward, lever 230 is forced slightly downward within spacing 240 to enable retention bump 270 to clear a retention bump 271. The second fastener is fixedly attached to lever 230. As a result, the second fastener laterally shifts within the slot to allow the second fastener to become disengaged when the display housing is rotated in a counter-clockwise direction.

Of course, as yet another alternative, it is contemplated that lever 230 may be implemented with two or more retention bumps while spacing 240 is implemented with one or more retention bumps.

[0045] It is further contemplated that lever 230 may be positioned merely along a surface of the back display panel, perhaps within the recessed area instead of within spacing 240. This would warrant lever 230 to be configured generally flat in order to minimize the amount of space needed for lever 230.

[0046] Referring back to Figure 5, when electronic device 100 is placed in a CLOSED position, first fastener 210, equivalent to fastener 160 of Figure 1, is engaged with complementary fastener 162 of body case 120. This prevents angular rotation of display housing 110 and display support member 140. Also, second fastener 220 is engaged with slot 250 of display support member 140.

[0047] Referring now to Figure 9, a side elevation view of electronic device 100 placed in a partially OPENED position is shown. Herein, first fastener 210 is disengaged from complementary fastener 162, which allows display housing 110 to be vertically pivoted by hinge assembly 130 as depicted

by arrow 300. Second fastener 220 remains engaged with slot 250 so that both display housing 110 and display support member 140 are vertically pivoted simultaneously.

[0048] Referring to Figure 10, a side elevation view of display housing 110 being rotated about an axis of rotation provided by first and second hinge units 150 and 155 is shown. For this embodiment of the invention, second fastener 220 has disengaged from slot 250. This is accomplished in response to an event performed on interlocking mechanism 200 as depicted by arrow 290.

[0049] For instance, according to one embodiment of the invention, in response to an event performed on first fastener 210, lever 230 is laterally shifted from a first state to a second state. Examples of these events may include (i) depressing/pulling first fastener 210, (ii) twisting first fastener 210 in a circular motion, (iii) pivoting first fastener 210, or the like. This event causes biasing mechanism 260 to be adjusted and allows second fastener 220 to become disengaged from slot 250 upon rotation of display housing 110 is depicted by arrow 295.

[0050] As shown, when biasing mechanism 260 is implemented as a spring, lateral movement of lever 230 causes compression

of spring 260. This allows second fastener 220 to become disengaged from slot 250. When biasing mechanism 260 is implemented as retention bumps, however, lateral movement of lever 230 causes different retention bumps to maintain the lateral position of lever 230, but this again allows second fastener 220 to become disengaged from slot 250.

[0051] After second fastener 220 becomes disengaged from slot 250, display housing 110 can be freely rotated on an axis of rotation provided by first and second hinge units 150 and 155. As one embodiment, the maximum degree of rotation provided by hinge units 150 and 155 is approximately 180 degrees. First hinge unit 150 may be implemented with a brake mechanism. This would enable display housing 110 to be maintained at certain degrees of rotation.

[0052] As further shown in Figure 10, display housing 110 is rotated in a counter-clockwise direction as represented by arrow 295 in order to invert display housing 110. As a result, back display panel 114 of display housing 110 is adapted to be flush against top panel section 122 of body case 120 and display support member 140 as shown in Figure 11. Front display panel 112 would be viewable by the user. Moreover, during rotation of display housing 110, display

support member 140 forms a dual member assembly to enhance support of the flat panel display.

[0053] Referring now to Figure 12, a perspective view of an embodiment of display support member 140 is shown. Display support member 140 comprises a first member 300 and a second member 320. In general, first member 300 is pivotally coupled to both hinge assembly 130 and first hinge unit 150. Second member 320 is pivotally coupled to hinge assembly 130 and second hinge unit 155. Both hinge units 150 and 155 are positioned in recessed area 115 of back display panel 114.

[0054] First member 300 includes a recessed area 305 sized to accommodate second member 320 during all positions except when display housing 110 is being rotated about an axis of rotation provided by hinge units 150 and 155. More specifically, as one embodiment of the invention, recessed area 305 includes a plurality of recessed portions such as recessed portions 306 and 307 for example. A first recessed portion 306 is configured to receive protrusions 325 of second member 320 when electronic device 100 is placed in a CLOSED position. In this position, second member 320 is substantially coplanar to first member 300.

[0055] As further shown in Figure 12, a second recessed portion 307 operates as slot 250 for second fastener 220, which is illustrated as a fastener having dual prongs separated by a width slightly exceeding the width of second member 320. Where second fastener 220 is a single prong fastener, only a part of second recessed portion 307 is needed as slot 250. However, when display housing 110 is completely inverted, second recessed portion 307 receives protrusions 325 of second member 320.

[0056] Referring back to Figures 9 and 10, initial counter-clockwise rotation of display housing 110 along an axis of rotation established by first hinge unit 150 causes second member 320, substantially coplanar to recessed area 305 and first member 300, to move away from first member 300. Continued counter-clockwise rotation further separates second member 320 from first member 300 so that first member 300 and second member 320 are substantially in parallel and separated by a predetermined distance. In one embodiment, the predetermined distance exceeds one-quarter of an inch; however, any predetermined distance can be accommodated.

[0057] Further counter-clockwise rotation of display housing 110 along an axis of rotation established by first hinge unit 150, generally exceeding 90 degrees from its non-

rotated state in the OPENED position, causes reduced separation of first member 300 and second member 320. When display housing 110 is fully inverted, second member 320 is again positioned in recessed area 305 of first member 300 and generally as coplanar to first member 300.

[0058] Referring back again to Figure 11, a side elevation view of electronic device 100 in which display housing 110 has been fully inverted is shown. Herein, display support member 140 is now interposed between display housing 110 and body case 120. Second fastener 220 of interlocking mechanism 200 is configured so as to not protrude above a depth of recessed area 115. This prevents second fastener 220 from causing scratching and other physical damage to body case 120 when electronic device 100 is placed in an INVERTED position.

[0059] While certain exemplary embodiments of the invention have been described and shown in the accompanying drawings, it is to be understood that such embodiments are merely illustrative of and not restrictive on the broad aspects of various embodiments of the invention, and that these embodiments not be limited to the specific constructions and arrangements shown and described, since various other modifications are possible.